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LARVAL FEEDING PREFERENCES OF *PLATYPREPIA GUTTATA* BOISDUVAL (ARCTIIDAE) FROM BEACH HABITAT AT POINT REYES NATIONAL SEASHORE, CALFORNIA

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ABSTRACT. Preferences of *Platyprepia guttata* caterpillars among foliage of 10 species of beach plants were determined in a laboratory experiment. *Cakile maritima*, *Lathyrus littoralis*, and *Mesembryanthemum chilense* (in that order) were preferred species; *Camissonia cheiranthifolia* ssp. *cheiranthifolia* and *Abronia latifolia* were secondary species; and *Elymus mollis*, *Ammophila arenaria*, *Ambrosia chamissonis*, *Atriplex leucophylla*, and *Calystegia soldanella* were non-preferred species. Sampling transects showed 51% of *Cakile* seedlings in the field were damaged by herbivores, implying that *Platyprepia* herbivory might have significant effects upon survival of *Cakile*.

Additional key words: plant population biology, *Cakile*, *Lathyrus*, *Mesembryanthemum*, Brassicaceae.

Herbivores may greatly influence the species composition of plant communities (Harper 1977). Insect herbivores often exhibit a temporal periodicity of abundance, during the peaks of which their influence is highly apparent. Causes of these 'outbreaks', and their effects on vegetation, have received increased attention in recent years (Barbosa & Schultz 1987).

The importance of herbivory in beach habitats rarely has been examined due to the obvious importance of physical factors such as salt spray (Barbour 1978, Barbour & DeJong 1977), wave disturbance (Payne & Maun 1984), etc. Yet a few studies indicate that insect herbivores may have a significant influence on the population biology of beach plants. Payne and Maun (1984) found a variety of insects attacked *Cakile edentula* (Bigel.) Hook. ssp. *edentula* var. *lacustris* Fernald (Brassicaceae) on a Lake Huron beach, and Keddy (1980) reported an outbreak of caterpillars which affected survival of East Coast *Cakile edentula* (Bigel.) Hook. ssp. *edentula* var. *edentula* plants.

Platyprepia guttata Boisduval (Arctiidae), the only species of the genus in North America, is found along the West Coast from northern California to Puget Sound, and thence inland to Colorado, Wyoming, and Montana (Holland 1915). During several years of field work on the biology of the beach plant *Cakile maritima* Scop. at Point Reyes National Seashore, I noted caterpillars of *Platyprepia* in some years but not others. In outbreak years, larvae apparently moved away from hinddune areas into beach (foredune and open beach) areas. In 1983, an outbreak of *Platyprepia* caterpillars was large enough that they could

be found wandering on the open beach in the area washed by waves. During such outbreak years, *Platyprepia* may be abundant enough to have noticeable effects on plants in the beach habitat. Powell and Hogue (1979) mention *Platyprepia* is "common" at Point Reyes National Seashore and Pitts (1976) reported larvae as "abundant" on her Point Reyes study site.

Larval feeding preferences of *P. guttata* are virtually unknown. The reported larval food plant is bush lupine, *Lupinus arboreus* Sims (Tietz 1972), but larvae also have been reported to feed on *Amsinckia spectabilis* F. & M. (Boraginaceae) and *Cakile maritima* (Pitts 1976). Powell and Hogue (1979) stated larvae could be found "on bush lupine and probably other plants", but no preference study for plants from the beach habitat had yet been conducted. This study was designed to examine the feeding preferences of *Platyprepia* caterpillars to determine which beach species would be most affected by them during outbreak years.

METHODS

Point Reyes National Seashore is located on the California coast 50 km north of San Francisco. The northern beach of Point Reyes National Seashore forms one of the longest unbroken stretches of beach in northern California, extending 18 km. As with many northern West Coast beaches (Barbour et al. 1976), the foredune of the majority of this beach is dominated by the introduced grass *Ammophila arenaria* (L.) Link (Poaceae). One exception is a 1-km section of Kehoe Beach, where *Ammophila* patches are found interspersed with patches of the native grass, *Elymus mollis* Trin. ex Spreng. (Poaceae). The *Elymus* areas contain other beach plant taxa that are relatively scarce in the *Ammophila* areas. The 10 beach taxa selected for the preference experiment (see Table 1) were reported by Barbour et al. (1976) to be characteristic members of the beach community in California. Voucher specimens of these taxa were collected in an earlier study of plant–animal interactions in the beach habitat in this area of Point Reyes National Seashore (Pitts & Barbour 1979) and were deposited in the Carl W. Sharsmith Herbarium, San Jose State University.

Larvae were collected in late May on the foredune area of the beach near Abbott's Lagoon at Point Reyes National Seashore. Most of those collected were found on *Cakile* plants. Larvae were probably in their final instar, as many of them pupated before being released after the end of the experiment. Larvae were fed Romaine lettuce (*Lactuca sativa* L., Asteraceae) for 3 days, starved 1 day, and then placed in feeding containers. Feeding containers were an aluminum pie tin for the bottom with the top being a second inverted tin. A small piece of

sponge was wired to the inside of the top and soaked with water to elevate humidity inside the feeding container to maintain plant freshness.

Plant samples were collected from the same area where larvae were obtained. A sample was the terminal portion of a forb stem, or an entire leafy shoot in the case of grasses. For forbs, one sample was taken from each clump encountered in the field. For grasses, one sample was taken every several meters of beachfront. Samples were sealed into plastic bags, taken to the laboratory, refrigerated, and used the following day. Forb shoots were trimmed to fit the feeding containers, yet have both young and old leaves present. One stem of each forb species was placed in each container. For grasses, 6-cm segments were cut from younger leaves and 4 placed together in a container to make up a sample. Plant samples were weighed and a larva placed into each of 44 containers. Nine additional containers, selected with a random numbers table, contained no larvae as controls. Samples were reweighed and examined for evidence of feeding damage daily for 3 days.

Moisture content of the plant samples was determined by gathering the control samples of each species into a paper bag and drying them at room temperature for several weeks. Initial weights for each species were totalled and compared to the collective dry weight to calculate initial percent moisture.

Transects to evaluate herbivore damage to *Cakile* in the field were established at Point Reyes National Seashore about 1 km south of Kehoe Creek in an area with abundant *Cakile*. I selected a location for the first transect and then established 14 subsequent ones spaced at 20-m intervals. Each 1-m-wide transect began at the seaward limit of the foredune and extended landward to the dune crest perpendicular to the shoreline. All *Cakile* seedlings found were examined for evidence of herbivory on 13 May 1983.

Results and Discussion

Larvae showed a definite preference for the foliage of some beach taxa. Damage frequency curves indicate three levels of preference among the foliage offered (Fig. 1). *Cakile* and *Lathyrus* were highly preferred by the larvae on day 1, with at least two-thirds of the samples of both taxa showing some signs of herbivory. By day 2, about 50% of the samples of *Abronia* and *Mesembryanthemum* had been damaged, indicating they were secondary choices of the larvae. The remainder of the taxa offered were damaged in less than 33% of the trays by the third day, indicating that they were not preferred species.

Weight loss data verify some of these results, but show that in some cases damage was frequent but not severe or vice versa. Damaged

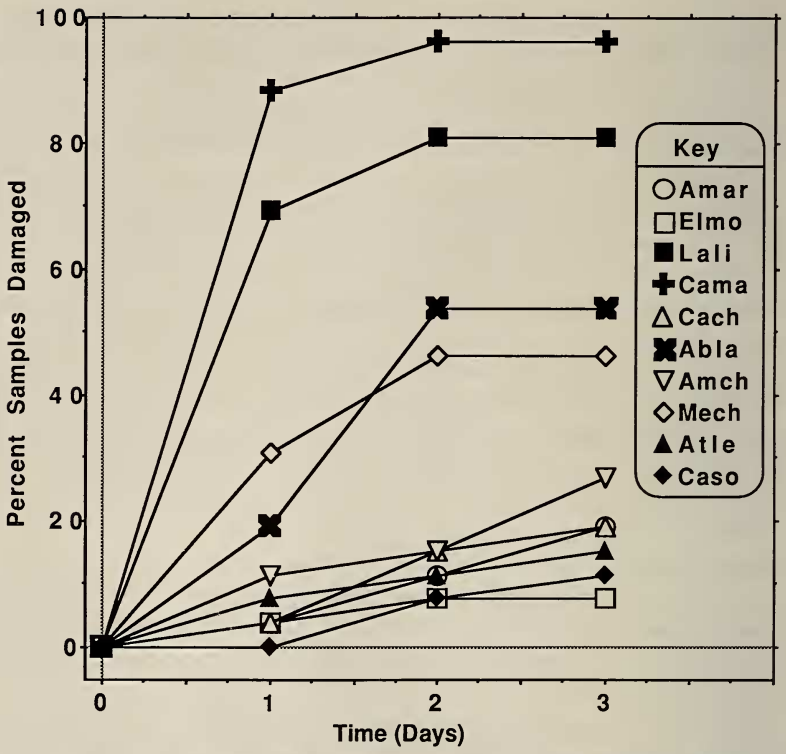

FIG. 1. Daily damage frequencies for the 10 plant species tested. Frequency data were compiled only from those feeding containers in which at least one plant sample was damaged by *Platyprepia guttata*. Species abbreviations are as listed in Table 1.

samples of *Cakile*, *Lathyrus*, and *Mesembryanthemum* all lost significantly more weight than undamaged samples (Table 1). Weight loss of damaged *Cakile* samples was greatest of all plant taxa (59%, versus 16% for undamaged samples), with some samples being almost completely consumed. *Lathyrus* and *Mesembryanthemum* were consumed less completely (Table 1). *Abronia*, which on the basis of damage frequency was a secondary choice of the larvae, was not consumed in detectable quantities. *Camissonia*, which was damaged quite infrequently, was consumed in quantity when damaged, resulting in statistically significant weight loss. Considering both damage frequency and the extent of damage to the samples, I conclude that the preference ranking was: *Cakile*, *Lathyrus*, *Mesembryanthemum* as preferred species (in that order); *Camissonia* and *Abronia* as secondary species; and the remainder as non-preferred species.

There was a general trend for preferred species to be those with higher moisture contents. Two of the three preferred species (*Cakile*

TABLE 1. Plant species tested for feeding preference by *Platyprepia guttata*. Moisture and weight loss data of damaged and undamaged leaves are also presented. Weight loss data are expressed as the percentage lost by the third day of the experiment (mean ± standard deviation, N in parentheses). Pairs of values for weight loss data marked with an asterisk (*) indicate a statistically significant difference between damaged and undamaged foliage (Mann-Whitney *U*-test, $P < 0.05$).

Species (family)	Abbreviation	% moisture	Weight loss (%) after 3 days	
			Damaged	Undamaged
Elymus mollis Trin. ex Spreng. (Poaceae)	Elmo	47.2	23 ± 3.7 (2)	22 ± 4.4 (51)
Ammophila arenaria (L.) Link. (Poaceae)	Amar	32.2	25 ± 9.8 (4)	29 ± 6.1 (49)
Cakile maritima Scop. (Brassicaceae)	Cama	88.4	59 ± 29 (25)*	16 ± 5.7 (28)*
Mesembryanthemum chilense Mol. (Aizoaceae)	Mech	91.0	8.3 ± 3.0 (12)*	4.5 ± 1.3 (41)*
Abronia latifolia Eschs. (Nyctaginaceae)	Abla	80.4	15 ± 3.5 (14)	14 ± 4.1 (39)
Ambrosia chamissonis (Less.) Greene (Asteraceae)	Amch	73.7	30 ± 5.3 (8)	26 ± 6.0 (44)
Atriplex leucophylla (Moq.) D. Dietr. (Chenopodiaceae)	Atle	68.2	26 ± 23 (4)	9.5 ± 6.6 (49)
Calystegia soldanella (L.) R. Br. (Convolvulaceae)	Caso	82.8	18 ± 4.5 (3)	19 ± 5.8 (49)
Lathyrus littoralis (Nutt. ex T. & G.) Endl. (Fabaceae)	Lali	61.9	36 ± 19 (21)*	20 ± 4.9 (32)*
Camissonia cheiranthifolia (Hornem. ex Spreng.) Raimann in Eng. & Prantl ssp. *cheiranthifolia* (Onagraceae)	Cach	72.9	36 ± 6.4 (5)*	25 ± 7.2 (48)*

and *Mesembryanthemum*) had the highest moisture contents (Table 1), whereas most of the non-preferred species had relatively low moisture contents. The major exception to this trend was *Lathyrus*, which had a low moisture content relative to other species yet was second only to *Cakile* in preference.

The preference of *Platyprepia* for *Cakile* and *Lathyrus* is interesting, as these two taxa belong to different plant families in which the foliage is chemically defended in different ways. *Cakile*, a member of the Brassicaceae, contains glucosinolates (Rodman 1974), whereas *Lathyrus*, a member of the Fabaceae, is protected by phytoalexins (Robeson & Harborne 1980) and alkaloids (Mears & Mabry 1971). Preference of *Platyprepia* for *Lathyrus* is not surprising. Its reported host plant, *Lupinus arboreus* (Tietz 1972), is another member of the Fabaceae in a genus also protected by alkaloids (Mears & Mabry 1971).

It is surprising that *Platyprepia* damaged some of the species tested. For example, Huiskes (1979) reported *Ammophila arenaria* to be relatively unpalatable to both vertebrate and invertebrate herbivores. In

this experiment *Ammophila* was not preferred, but damage frequency was higher than for other non-preferred species (Fig. 1).

Besides *Lupinus arboreus*, *Platyprepia* larvae have been reported to feed on *Amsinckia spectabilis* F. & M. and *Cakile maritima* (Pitts 1976). Pitts (1976) reported that *Platyprepia* was "abundant" on her foredune study site at Point Reyes and consumed *Amsinckia* and *Cakile* blossoms. In my experiment, larvae avidly consumed leaves of *Cakile*, along with foliage of *Lathyrus* and *Mesembryanthemum*. *Lathyrus* was present on her study site but not reported as a host for *Platyprepia* (Pitts 1976).

More than half (51% of 175 individuals) of the first-year *Cakile* plants encountered in my foredune sampling transects had been damaged by herbivores. Damage varied greatly among individuals, but some small plants were almost leafless as a result of herbivore attack. I cannot be certain the damage was inflicted by *Platyprepia*, as other herbivores present in the area, e.g., the deer mouse, *Peromyscus maniculatus* (Wagner) (Muridae: Cricetinae), have been reported to consume *Cakile* foliage (Pitts & Barbour 1979).

Keddy (1980) studied the population biology of *C. edentula* ssp. *edentula* var. *edentula* on an East Coast beach gravel bar. He documented an outbreak of salt marsh caterpillars, *Estigmene acraea* (Drury), also in the Arctiidae, which killed at least 25% of the plants in the studied population. *Cakile maritima* is a facultative biennial in California, and is the only one of the species tested in this study which is not perennial. It germinates from October to May in California, so that some plants are very small when *Platyprepia* outbreaks occur (April–June). Young seedlings probably would be unable to recover from defoliation by *Platyprepia*. *Platyprepia*'s preference for *Cakile maritima* suggests it may play a role in *Cakile* population biology during outbreak years.

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